FEMA 1.209:210268

FLOOD INSURANCE STUDY

BALLARD COUNTY, KENTUCKY

UNINCORPORATED AREAS

SEPTEMBER 29, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER 210268

HQW

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

BALLARD COUNTY,
UNINCORPORATED AREAS,
KENTUCKY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Unincorporated Areas of Ballard County, Kentucky, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Mayfield Creek were performed by the U.S. Army Corps of Engineers (COE), Memphis District.

Flood profiles for the Mississippi River were also obtained from a COE, Memphis District report titled, "Mississippi River Frequency Flood Profiles" (Reference 1).

The hydrologic and hydraulic analyses for all other streams studied were performed by the COE, Louisville District, (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 15. This study was completed in January 1988.

1.3 Coordination

In August 1986, streams requiring detailed study were identified at a meeting attended by representatives of the Study Contractor, FEMA, and the county.

On November 2, 1988, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Ballard County, Kentucky. The area of study is shown on the Vicinity Map (Figure 1). The incorporated areas within the county were excluded from this study.

Flooding caused by overflow of the Mississippi River, the Ohio River, Sugar Creek, Sugar Creek Tributary, and Mayfield Creek was studied in detail.

Areas having low development potential or minimal flood hazards were previously studied using approximate analyses. The results were shown on the Flood Hazard Boundary Map for Ballard County, Kentucky (Reference 2) and are incorporated into this Flood Insurance Study.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through August 1989. The scope and methods of study were proposed to and agreed upon by FEMA and Ballard County.

2.2 Community Description

Ballard County is in the extreme western part of Kentucky in the Jackson Purchase Region. The county covers 259 square miles and is bordered by the Ohio River and Pulaski County, Illinois, on the north; McCracken County, Kentucky, on the east; Carlisle County, Kentucky, on the south; and Mississippi County, Missouri, and Alexander County, Illinois, on the west. Ballard County is served by U.S. Highways 51, 60, and 62; State Highways 118, 286, 358, and 440; and the Illinois Central Railroad. The 1980 population of Ballard County was reported to be 8,798 (Reference 3). The economy of the area is primarily supported by agriculture.

The climate of Ballard County is classified as humid continental, characterized by large annual and daily variations in temperature caused by the passing of cold or warm fronts and their associated centers of high and low pressure. The annual mean temperature is 59.6 degrees Fahrenheit (^{o}F). Summers are moderately warm and humid, and winters are reasonably cold and cloudy. The extreme temperatures of record are 104^{o}F in July 1954, and 5^{o}F in January 1963.

As is characteristic of continental climates, precipitation in Ballard County varies widely from year to year; however, it is normally abundant and well distributed throughout the year. Fall is typically the driest season. The mean annual precipitation is 45.23 inches and the mean number of days with precipitation of .01 inch or more is 114. The average annual snowfall is 9.0 inches.

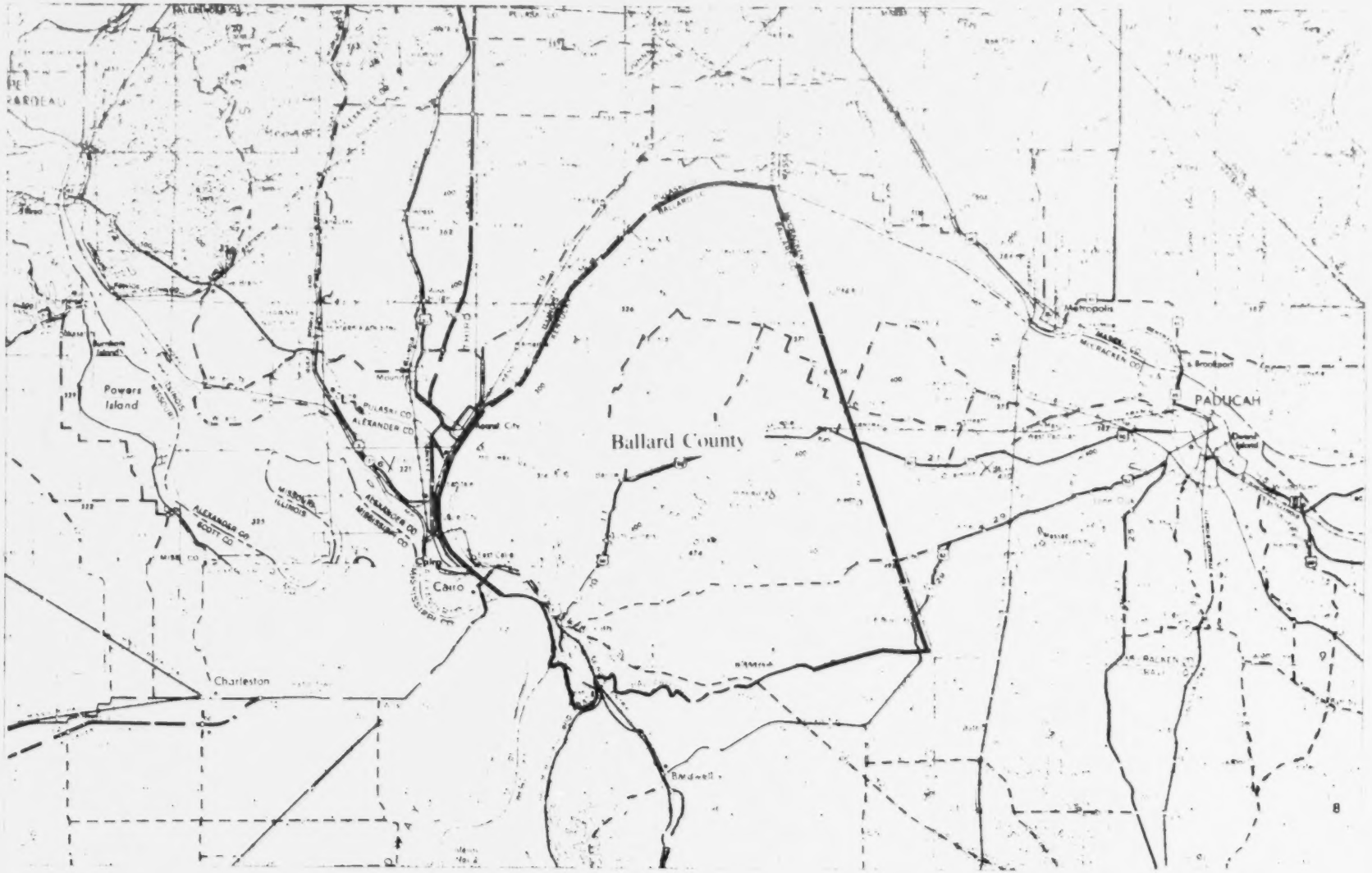


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

VICINITY MAP

2.3 Principal Flood Problems

Flood problems in Ballard County are caused mainly by the overflow of the Ohio and Mississippi Rivers. A large portion of the county is within the floodplains of those two major rivers. Significant floodplain areas are located along the rivers within the community.

2.4 Flood Protection Measures

While there are no flood protection facilities within the study area, flood stages along the Ohio and Mississippi Rivers in Ballard County are affected by numerous floodwater storage projects in the Ohio, Upper Mississippi, and Missouri River Basins. The navigation system on the Mississippi River and lower Ohio River is not regulated by locks and dams. The regulated portion of the Ohio River system commences at Lock and Dam 53, near Monkey's Eyebrow, Kentucky. Lock and Dam 53 is a navigation dam and has no effect on flood stages.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that is expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Natural discharge-frequency curves for the Ohio River were developed using COE methods (Reference 4). Modified discharge-frequency curves for the Ohio River were developed by routing 12 representative floods for the Ohio River modified by an upstream reservoir system. That system included reservoirs completed or near completion in 1976.

The discharges for Sugar Creek and Mayfield Creek were obtained from the COE "Mayfield Creek, Kentucky, Feasibility Report" (Reference 5).

The discharges for Sugar Creek Tributary and Sugar Creek above Sugar Creek Tributary were determined using square root drainage area proportion.

Peak discharge-drainage area relationships for the 100-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS*) 100-YEAR
MISSISSIPPI RIVER		
at Wickliffe, Kentucky	917,400	1,895,000
OHIO RIVER		
at Cairo, Illinois	203,943	1,275,000
MAYFIELD CREEK		
at confluence with Mississippi River	440	32,618
SUGAR CREEK		
at mouth	7.86	5,350
just upstream of confluence of Sugar Creek Tributary	2.88	3,240
SUGAR CREEK TRIBUTARY		
at mouth	4.07	3,850

*cubic feet per second

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations for the 100-year flood were computed using the HEC-2 computer program (Reference 6). Cross-section data for the streams studied were obtained from field survey and topographic maps at a scale of 1:24000 with contour intervals of 5 and 10 feet (Reference 7).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and on the Flood Insurance Rate Map.

Roughness coefficients (Manning's "n") for the water-surface computations were assigned on the basis of field inspection of the channels and floodplains and are listed below.

STREAM	CHANNEL	OVERBANK
Ohio River	0.027-0.028	0.100
Sugar Creek	0.055	0.050-0.070
Sugar Creek Tributary	0.055	0.050

The starting water-surface elevation for Sugar Creek was determined by the slope-area method. The starting water-surface elevation for Sugar Creek Tributary was obtained from the Sugar Creek profile at the confluence of Sugar Creek Tributary.

The water-surface elevations for Mayfield Creek were obtained from the COE feasibility report (Reference 5).

The starting water-surface elevation of the Ohio River was obtained from rating curves developed at Cairo. One rating curve was based on historic floods on the Ohio River while Mississippi River elevations were low. The other rating curve was based on historic floods on the Ohio River while flooding was also occurring on the Mississippi River. The starting water-surface elevation was input into the HEC-2 run on the Ohio River using the latter rating curve. The flood profile was then drawn using the backwater elevation of the Mississippi River, intersecting with the profile from the HEC-2 program output.

The profiles for the Mississippi River (Reference 1) were developed by the COE, Memphis District, using a physical and an analytical model.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the map and described in the exhibit labeled Elevation Reference Marks.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24000 with contour intervals of 5 and 10 feet (Reference 7).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Hazard Boundary Map for Ballard County (Reference 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways for this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
SUGAR CREEK								
A	0.23	530	2188	2.4	351.8	345.9	346.9	1.0
B	0.77	400	1638	3.3	351.8	350.5	351.5	1.0
C	1.17	385	1503	3.6	354.9	354.9	355.9	1.0
D	1.22	407	1585	3.4	355.4	355.4	356.4	1.0
E	1.26	293	1260	4.2	355.9	355.9	356.9	1.0
F	1.30	124	539	9.9	356.8	356.8	357.1	0.3
G	1.45	134	817	4.0	360.0	360.0	361.0	1.0
H	1.50	241	816	4.0	361.3	361.3	362.2	0.9
I	1.63	302	1466	2.2	362.2	362.2	363.2	1.0
SUGAR CREEK TRIBUTARY								
A	0.10	299	1256	3.1	359.5	359.5	360.5	1.0

[1]MILES ABOVE MOUTH
[2]ELEVATIONS WITHOUT CONSIDERING BACKWATER EFFECT FROM MAYFIELD CREEK

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

FLOODWAY DATA

SUGAR CREEK - SUGAR CREEK TRIBUTARY

Along streams where floodways have not been computed, the community must ensure that the cumulative effect of development in the floodplain will not cause more than a 1.0-foot increase in the base flood elevations at any point within the community.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

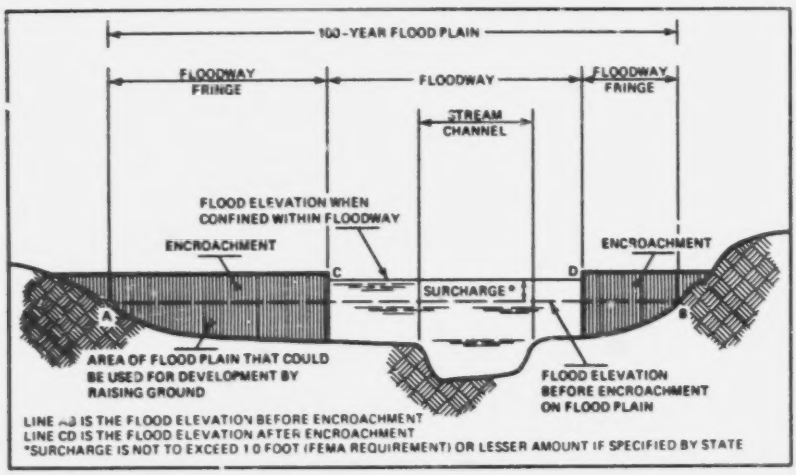

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The Ohio River profiles (Reference 8) used for this study were determined after the publication of the Flood Insurance Study for McCracken County, Kentucky (Reference 9) and, therefore, the elevations for the Ohio River contained in the Flood Insurance Study for McCracken County are not in agreement with the elevations in this study.

Flood Insurance Studies published for Alexander and Pulaski Counties, Illinois (Reference 10 and 11) and Mississippi County, Missouri (Reference 12) are in agreement with this study.

This Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for Ballard County (Reference 2).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

9.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Army Corps of Engineers, Memphis District, Mississippi River Frequency Flood Profiles, October 1978, unpublished.

2. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Ballard County, Unincorporated Areas, Kentucky, April 1977.

3. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Kentucky, Washington, D.C., February 1982.

4. U.S. Army Corps of Engineers, Sacramento District, Statistical Methods in Hydrology, Leo R. Beard, January 1962.

5. ————, Memphis District, Mayfield Creek, Kentucky, Feasibility Report, 1985-1986.

6. ————, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Computer Program 723-X6-L202A, Davis, California, April 1984.

7. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Intervals 5 and 10 Feet: LaCentor, Kentucky, 1975; Blandville, Kentucky, 1975; Wickliffe, Kentucky-Missouri, 1970; Wyatt, Missouri-Illinois, 1976; Cairo, Illinois-Kentucky, 1978; Bandana, Kentucky-Illinois, 1966; Olmsted, Illinois-Kentucky, 1967; Barlow, Kentucky-Illinois, 1975.

8. U.S. Army Corps of Engineers, Cincinnati District, Ohio River Profiles, January 1981.

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, McCracken County, Unincorporated Areas, Kentucky, June 1980.

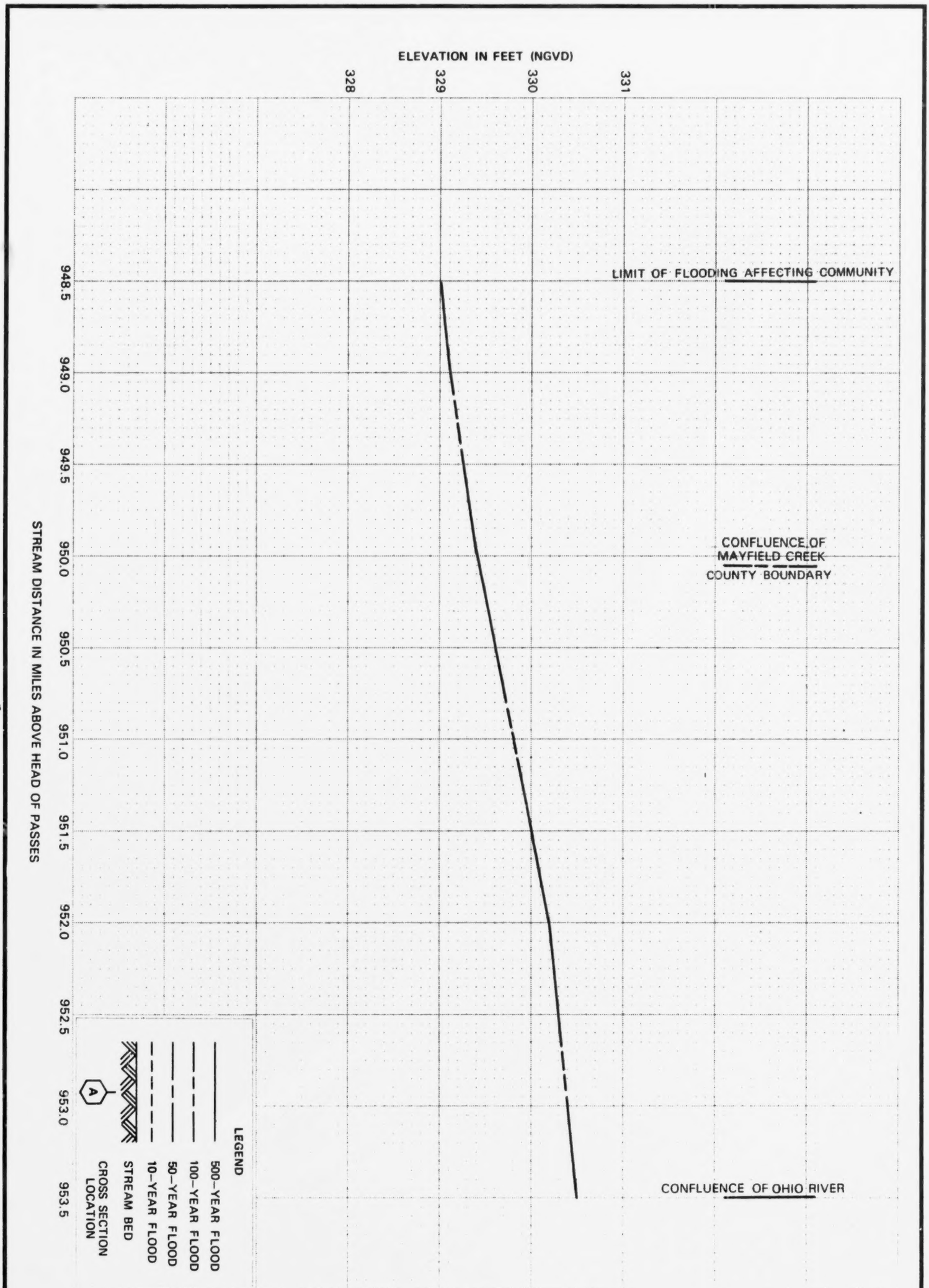
10. ————, Flood Insurance Study, Alexander County, Unincorporated Areas, Illinois, January 1986, revised November 1987.

11. ————, Flood Insurance Study, Pulaski County, Unincorporated Areas, Illinois, March 1985.

12. ————, Flood Insurance Study, Mississippi County, Unincorporated Areas, Missouri, January 1989.

ELEVATION REFERENCE MARKS

REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
1	0075	329.20	disk stamped "R 128 1947" set in northeast end of southeast abutment of U.S. Route 51 bridge over Miner Slough
2	0175	329.21	disk stamped "P 128 1947" set in southwest end of northwest abutment of U.S. Route 51 bridge over Flat Pond
3	0175	328.54	disk stamped "N 128 1947" set in northeast end of southeast abutment of U.S. Route 51 bridge over Flat Pond
4	0175	469.73	disk stamped "M 358 1957" set in top of concrete post located about 1.0 mile south along U.S. Route 51 from intersection of Fourth Street and U.S. Route 51
5	0175	346.66	disk stamped "Z 130 1947" set in northwest end of southwest abutment of U.S. Route 60 bridge over Cane Creek
6	0100	341.28	disk stamped "C 389 1968" set in top of copper rod encased in 6-inch iron pipe located 75 feet east of centerline of U.S. Route 60, about 1.6 miles north of intersection of U.S. Route 60 and State Route 1368
7	0205	357.11	chiseled square on curb of southwest corner of State Route 1837 bridge over Sugar Creek
8	0205	364.07	chiseled square on curb of southeast corner of U.S. Route 62 bridge over Sugar Creek



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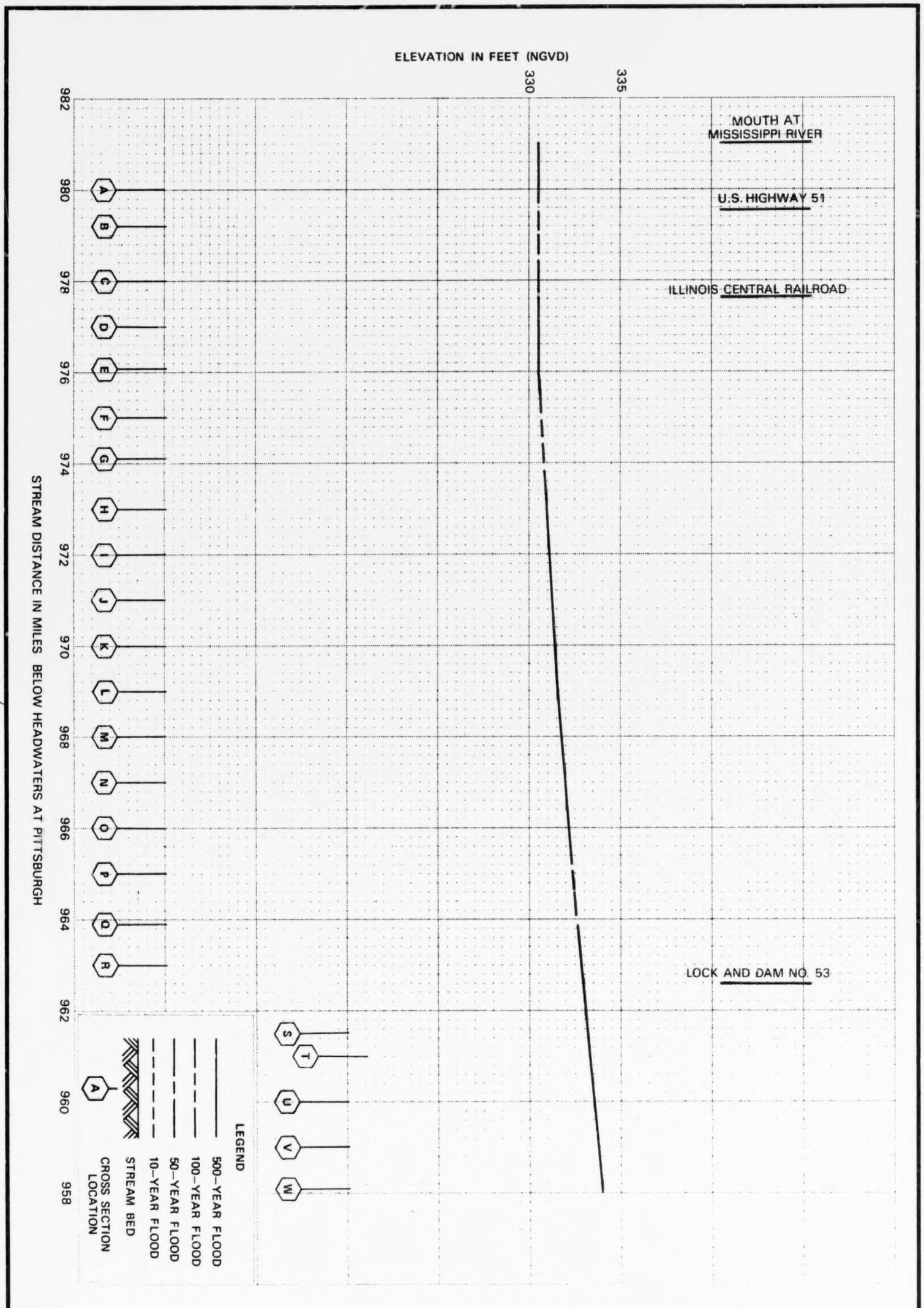
01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **BALLARD COUNTY, KY** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **MISSISSIPPI RIVER**



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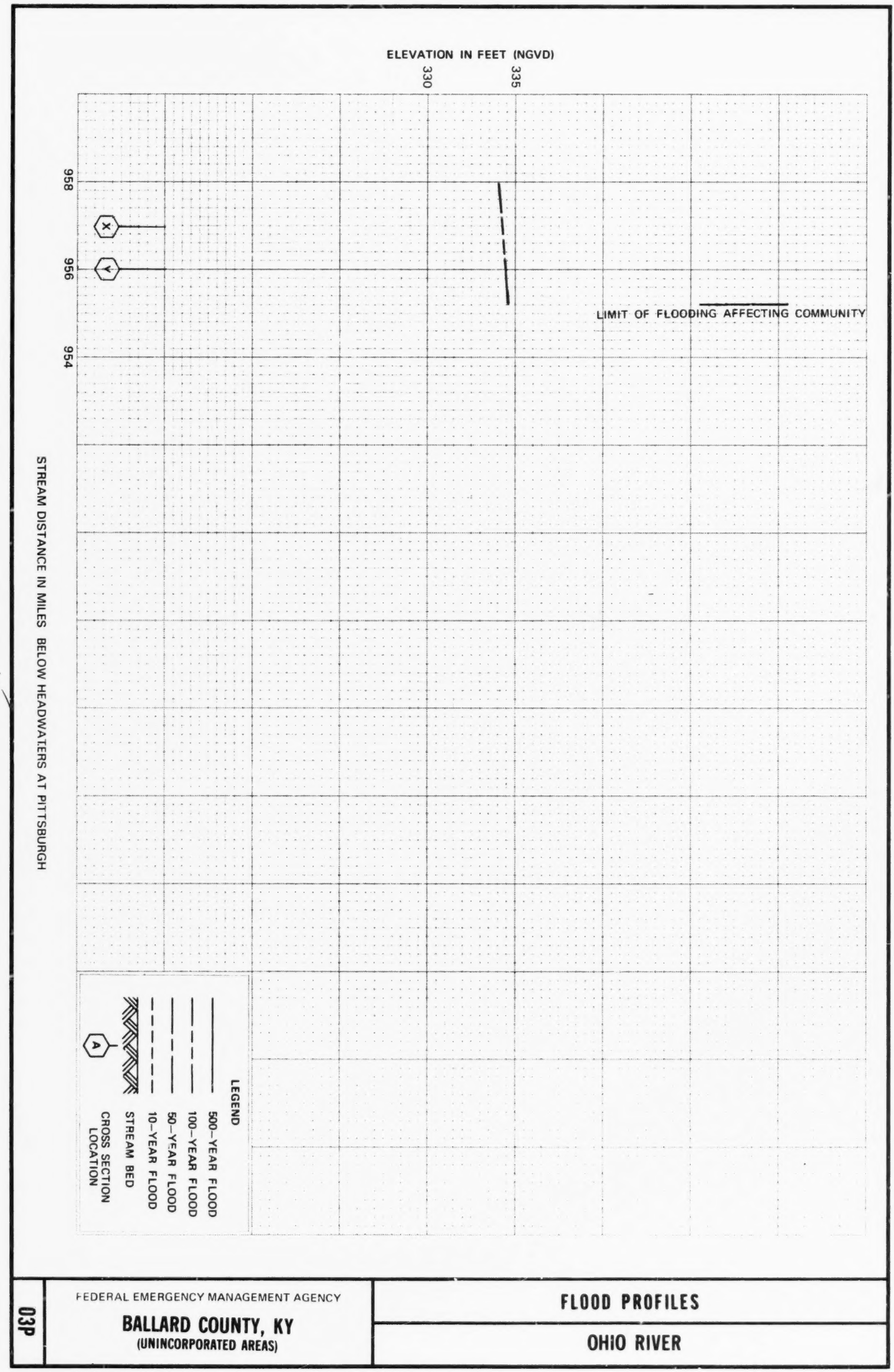
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

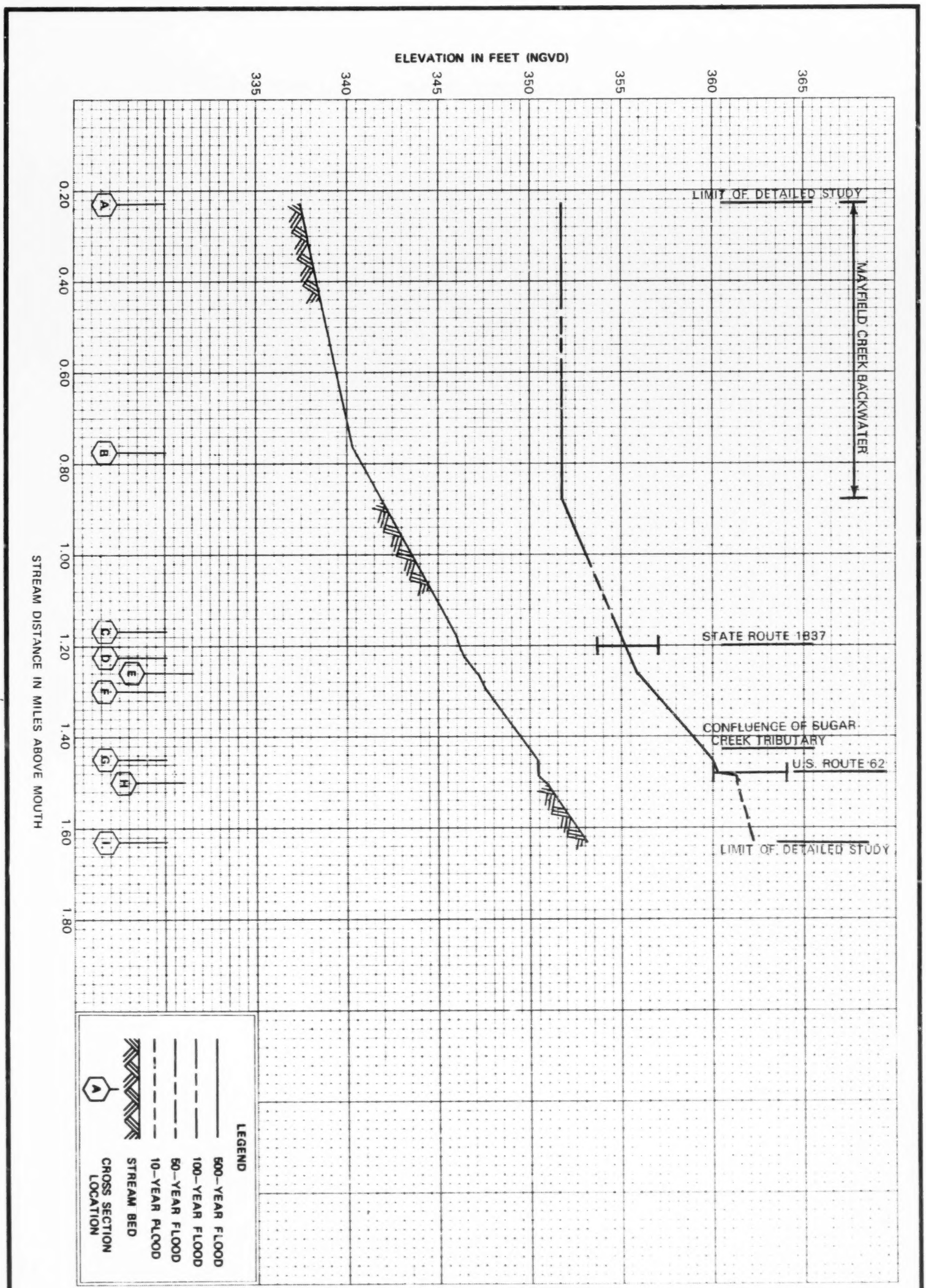
BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

FLOOD PROFILES

OHIO RIVER



03P	FEDERAL EMERGENCY MANAGEMENT AGENCY **BALLARD COUNTY, KY** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **OHIO RIVER**



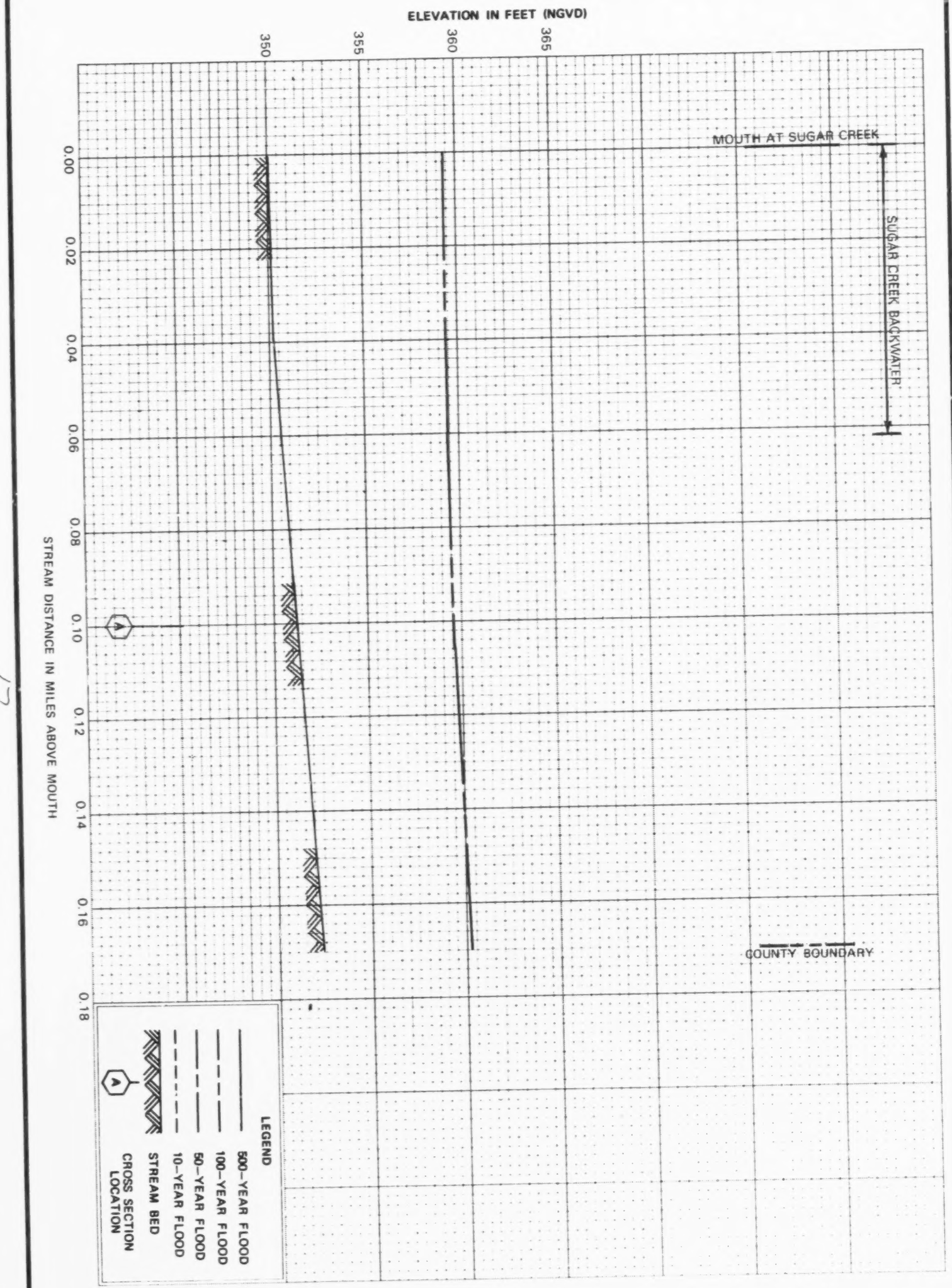
04P

FEDERAL EMERGENCY MANAGEMENT AGENCY

BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

FLOOD PROFILES

SUGAR CREEK



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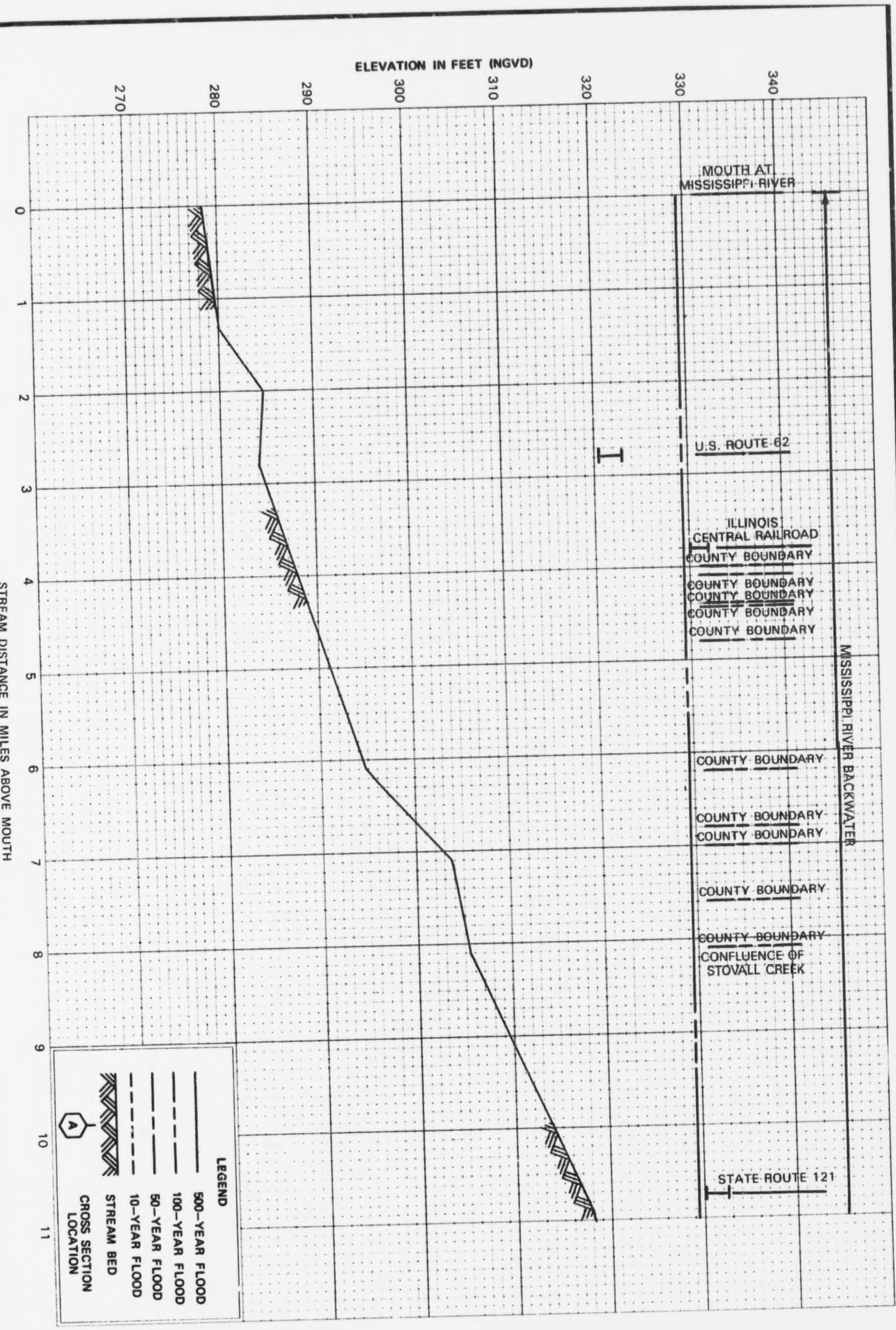
05P

FEDERAL EMERGENCY MANAGEMENT AGENCY

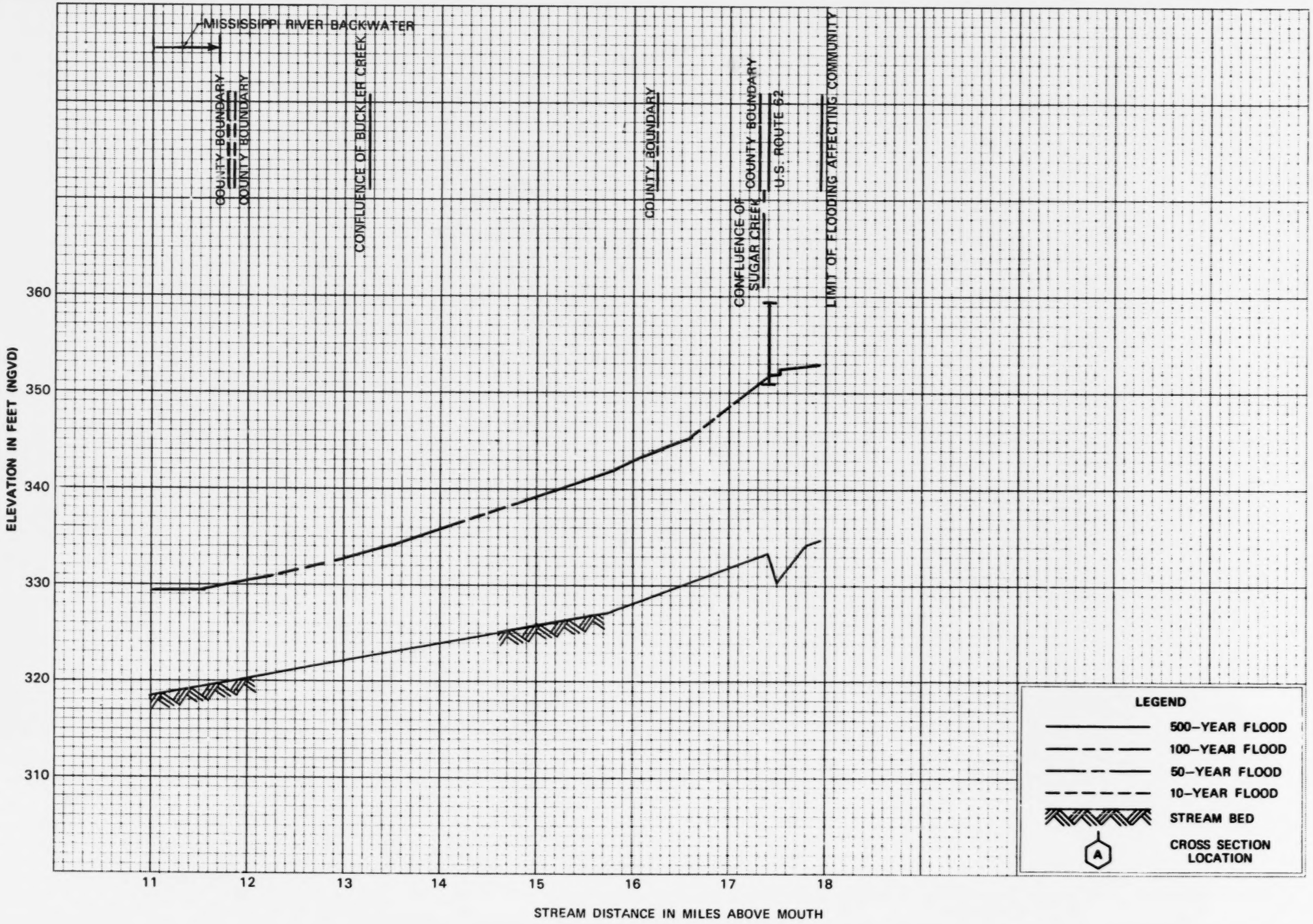
BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

FLOOD PROFILES

SUGAR CREEK TRIBUTARY



06P	FEDERAL EMERGENCY MANAGEMENT AGENCY **BALLARD COUNTY, KY** (UNINCORPORATED AREAS)	**FLOOD PROFILES** **MAYFIELD CREEK**



FLOOD PROFILES

MAYFIELD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BALLARD COUNTY, KY
(UNINCORPORATED AREAS)

07P